AOIT Computer Systems

Lesson 10

FRUs, Form Factors, and Ports

Student Resources

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Student Resource 10.1

Worksheet: FRU Chart

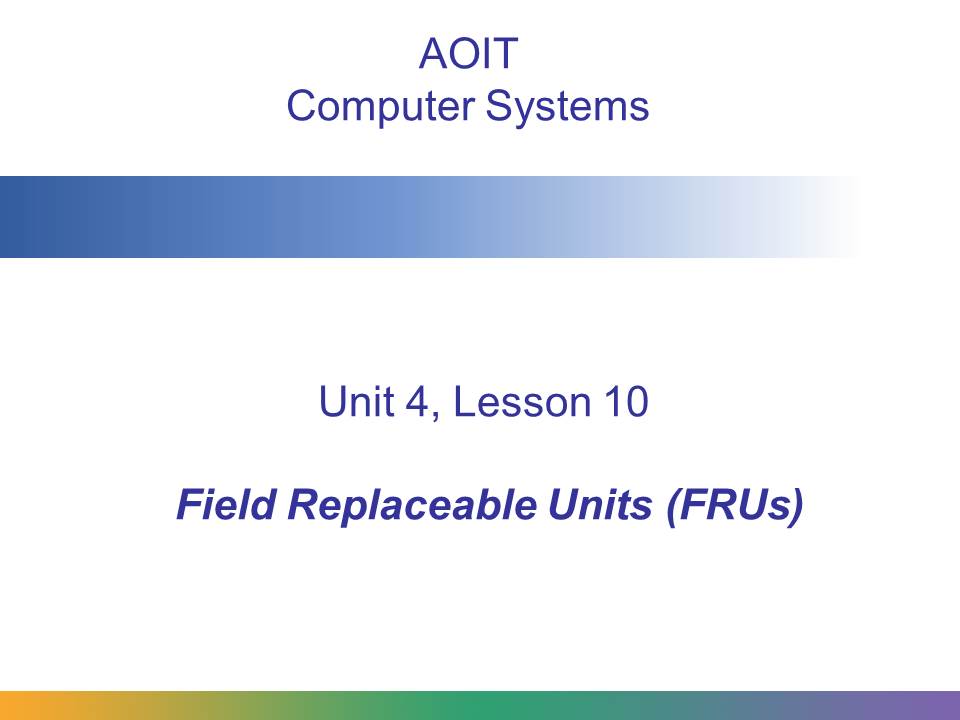
Student Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_

Directions: Examine the computer components that are displayed around the room. In the “Clues” column, list anything you can see on the FRU that makes it different from the others, such as size, shape, or brand name. In the “My Guess” column, write down what you think the FRU does, based on the clues. You will return to this worksheet after the next activity to fill in the “What I Learned” column.

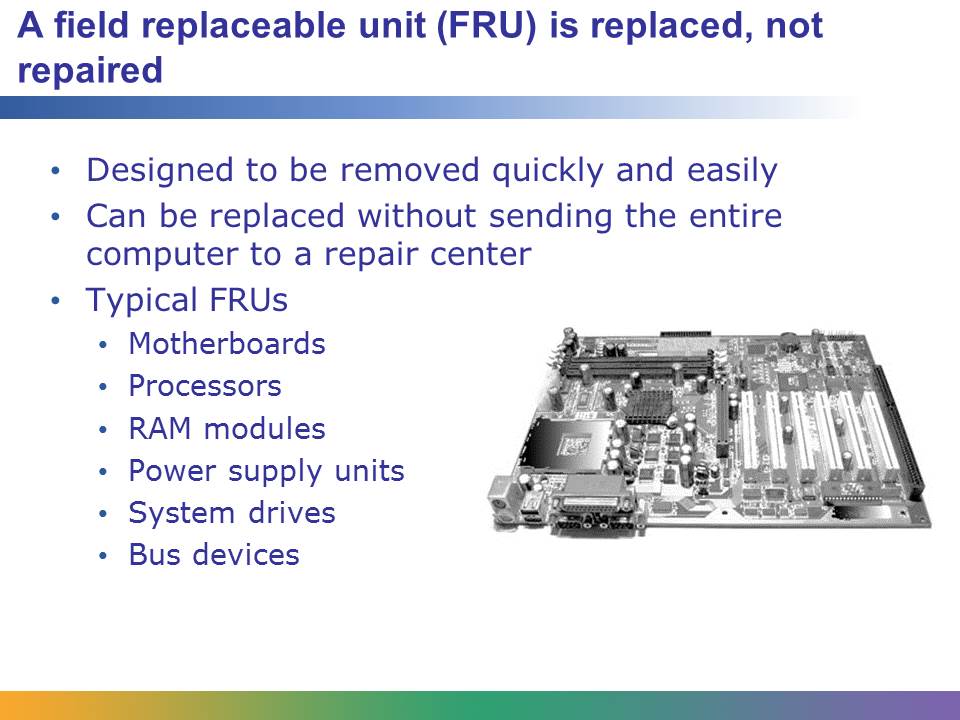
|  |  |  |  |
| --- | --- | --- | --- |
| # | Clues | My Guess | What I Learned |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |
| 5 |  |  |  |
| 6 |  |  |  |
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| 8 |  |  |  |
| 9 |  |  |  |
| 10 |  |  |  |

Student Resource 10.2

Reading: Field Replaceable Units (FRUs)



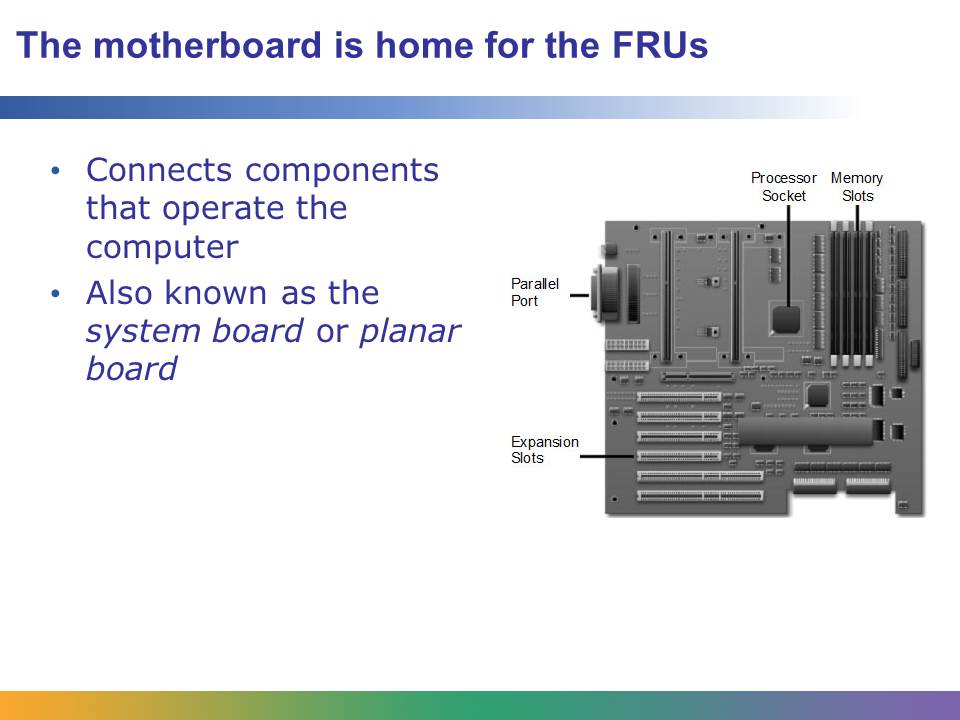
This presentation shows the components in a personal computer that are usually replaced rather than repaired. It shows how each component fits into a slot or socket on the motherboard and explains how they all fit together to form a working computer.



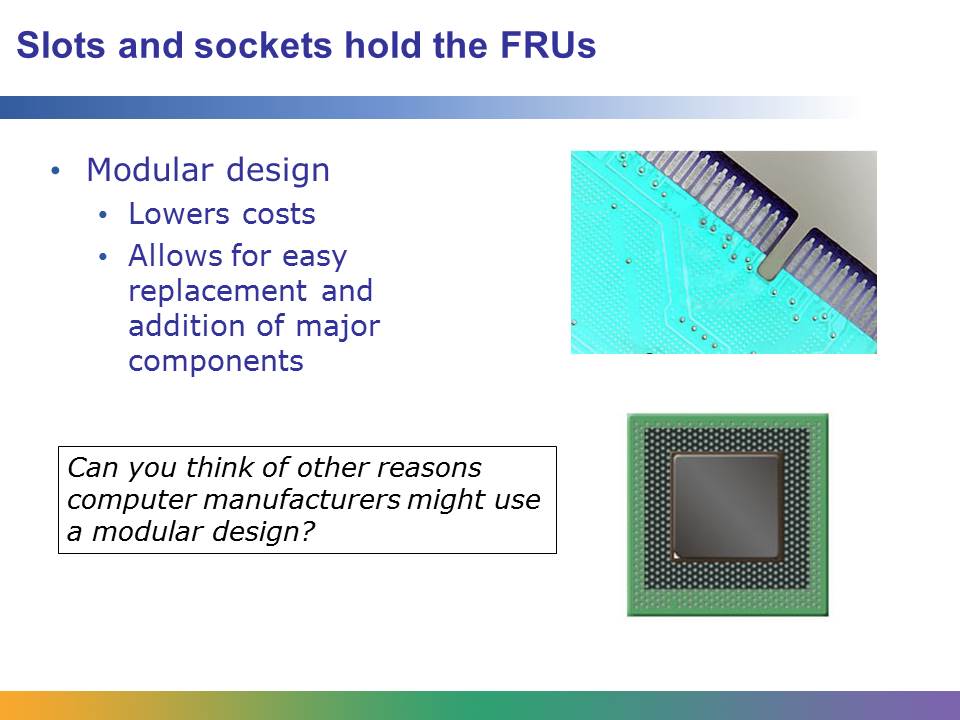
A FRU (rhymes with “true”) is a computer component that is usually replaced rather than repaired. FRUs are designed to be removed from the computer quickly and easily and can be replaced without sending the entire computer to a repair center.

Typical personal computer FRUs include the following:

* + Motherboards
  + Processors
  + RAM modules
  + Power supply units
  + System drives, such as floppy drives, hard drives, and optical drives
  + Bus devices, such as video cards and sound cards

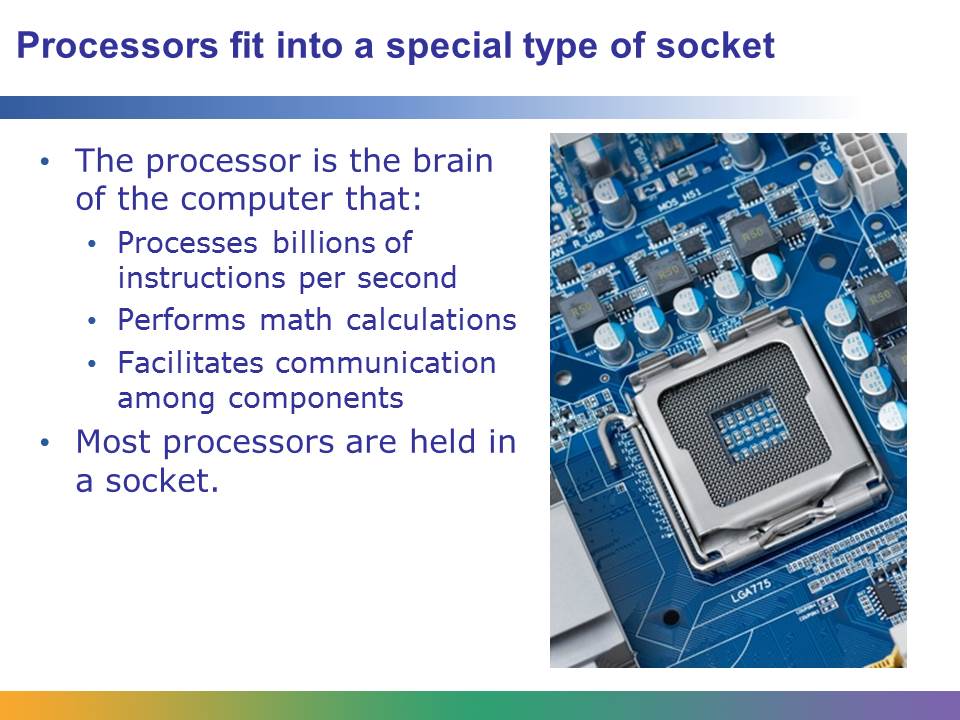


The motherboard, also known as the *system board* or *planar board*, is a large printed circuit board designed to connect to the components that make the computer operational. Motherboards are typically made of glass epoxy.



Slots and sockets, which are designed to hold a variety of FRUs, are soldered to the copper wires imprinted on both surfaces of the motherboard.

This modular design lowers computer production costs. It also allows for easy replacement of major components and the addition of new ones.

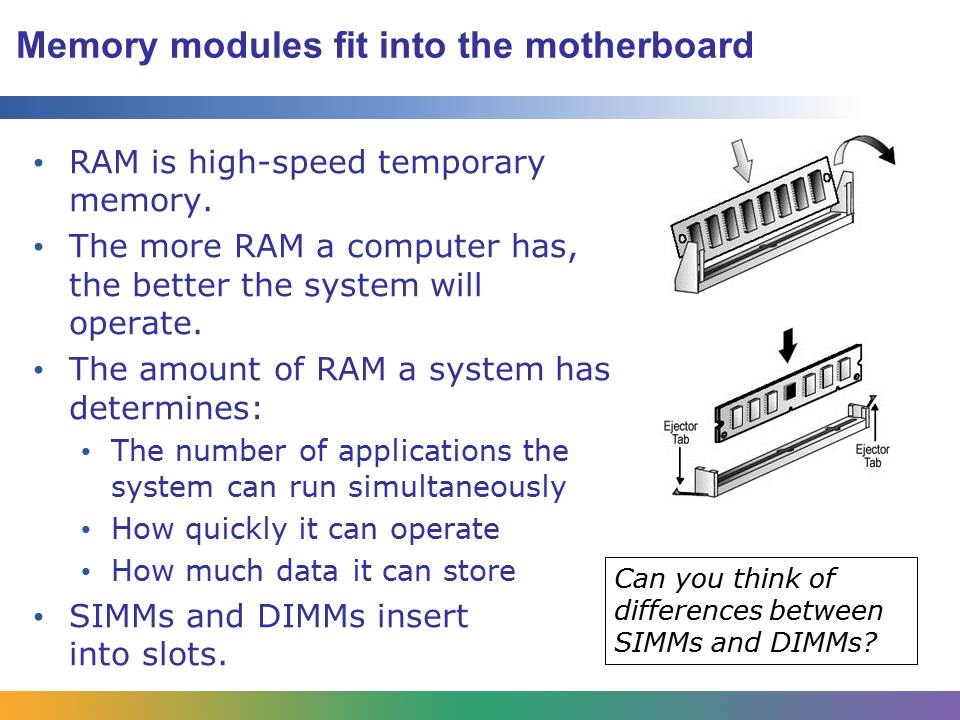


The processor, also known as the *central processing unit* (CPU), is the brain of the computer, directly or indirectly controlling all computer functions.

The speed and reliability with which a processor handles its tasks determine the overall performance of the computer.

The processor fits into a special type of socket on the motherboard. Because processors and their sockets can be easily damaged, a *zero insertion force* (ZIF) socket was invented. This socket has a small lever to help during removal and insertion and is keyed so that the processor can be inserted only one way.

Older processors were either soldered onto the motherboard or packaged in a type of cartridge that fit into a slot, similar to the way expansion cards or memory chips fit into slots.

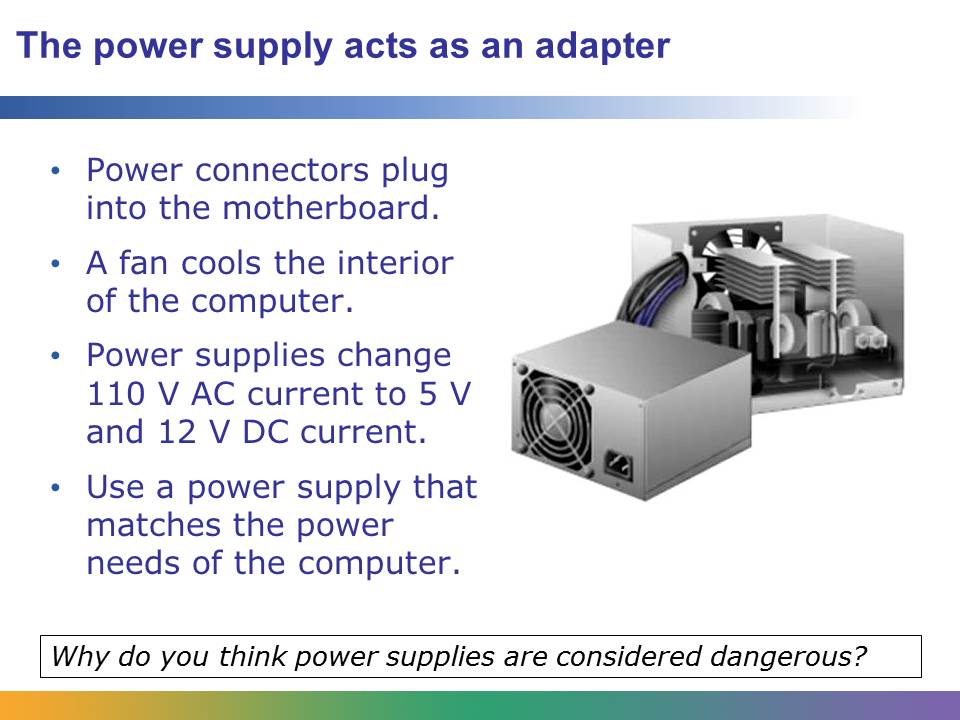


Also called *main memory*, random-access memory (RAM) is high-speed temporary memory. RAM holds currently used data so that the processor and operating system can access it quickly. RAM allows both “reads” and “writes,” which means that data in RAM can be displayed and modified. RAM is also volatile, which means that when the computer loses power, all data in RAM is erased.

The more RAM a computer has, the better the system will operate. The quantity of RAM a system has determines the following:

* + The number of applications the system can run simultaneously
  + How quickly it can operate
  + How much data it can store

RAM memory modules, called either *single inline memory modules* (SIMMs) or *dual inline memory modules* (DIMMs), insert into slots on the motherboard. SIMMs and DIMMs are not interchangeable; they are different sizes and they install into different types of sockets.

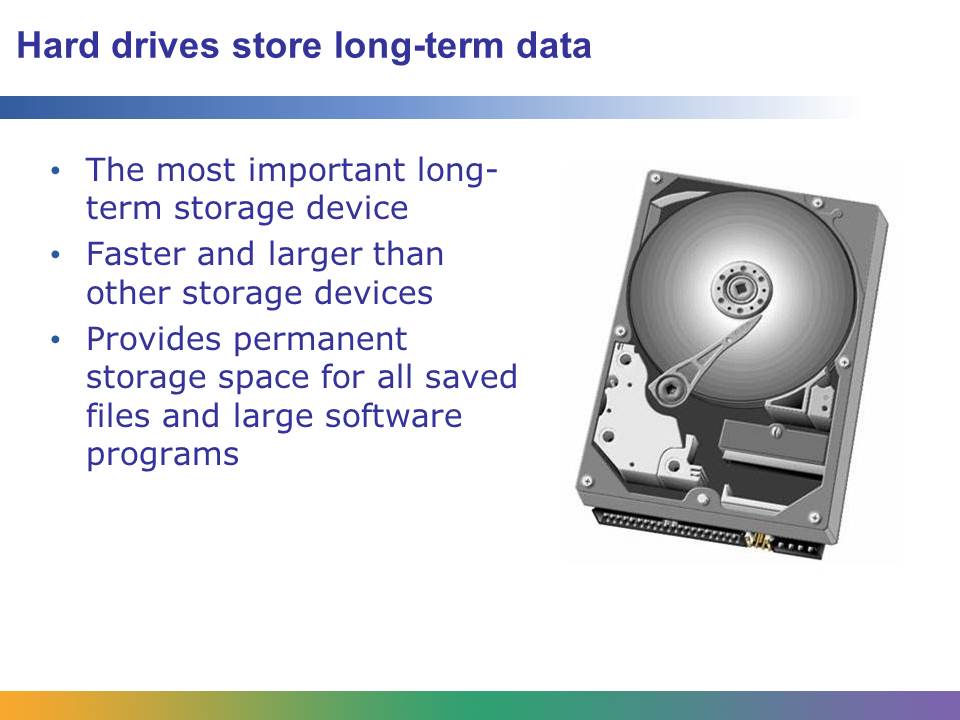


The power supply acts as an adapter, changing standard 110-volt AC current from the wall outlet to the 5 and 12 volts of DC current that the computer needs. The power supply connector on the motherboard provides the correct voltage to the various computer components. For example, 3.3 volts power the processor and other computer parts, but the motherboard and many of its components use 5 volts. The computer’s disk drive motors and fans run on 12 volts.

A power supply is rated by its output of watts. An average computer requires 200 watts of electricity to operate, which is a very small number when you consider that a household hair dryer requires seven times that output.

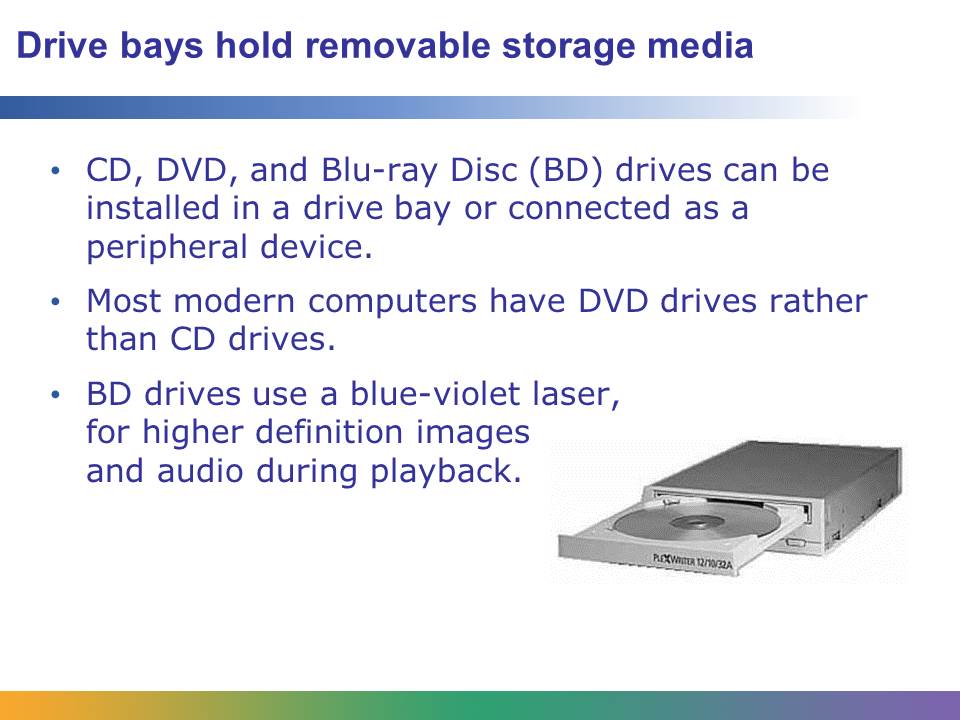
PC power supplies are fairly complex and dangerous, making them difficult to repair. The best option is not to repair a defective power supply but to replace it entirely. The replacement must be suitable for the system you are repairing. Check the unit’s voltage and wattage, and make sure it fits into the chassis.

It is important to use a power supply that is sized properly for the computer it is installed in. Using a power supply that is larger than necessary will be less efficient and can increase operating costs by wasting energy. On the other hand, using a power supply that is too small can impact system performance or not allow the computer to power on at all.



The hard drive is the most important long-term storage device in a computer. Much faster and larger than other storage devices, the hard drive provides permanent storage space for all saved files and large software programs.

Hard drive capacity continues to increase dramatically. Early hard drives stored only 10MB of data, but the newest hard drives in personal computers have a storage capacity of 500GB or more.



Optical disc drives use lasers to read and write data from discs that can be removed from the computer (unlike hard disk drives). This makes it easy to store and share data.

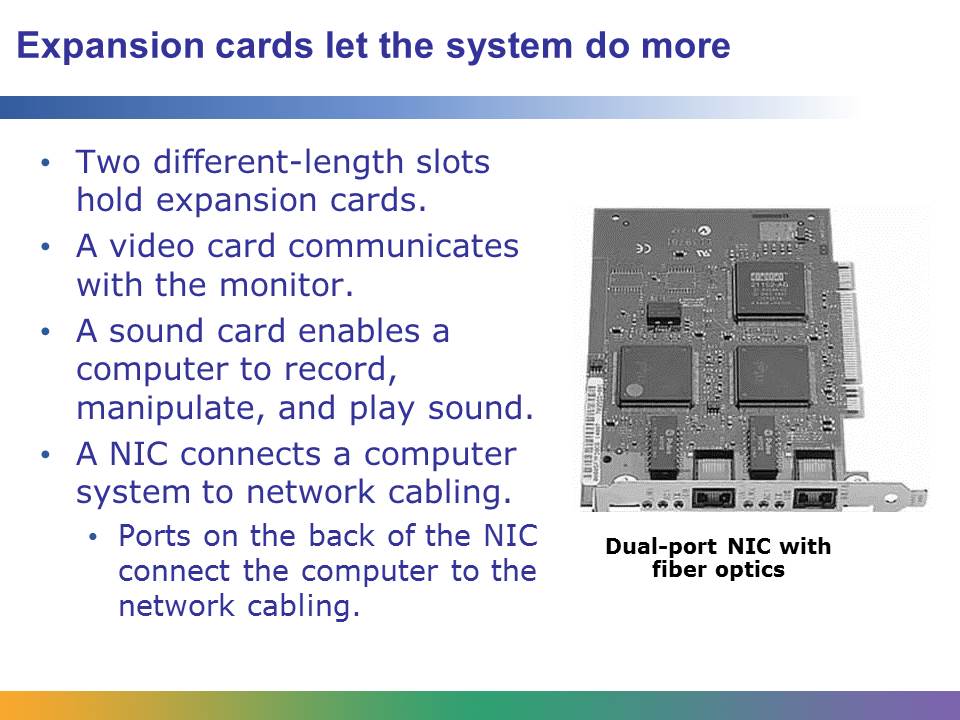
Compact disc (CD) drives were the first optical drives commonly used in PCs. CD drives could both read and record data. Recording data to a CD is also referred to as *burning* or *writing* data.

A DVD drive uses removable DVD media, which holds more than six times as much data as a CD. The technology supports access rates of 600 Kbps to 1.3 Mbps. DVD drives are backward-compatible with CDs, which means they can play old CDs and video CDs, as well as new DVDs.

CD lasers use a wavelength of 780 nm, which is within the infrared range of the light spectrum. The wavelength used by DVDs is 650 nm, which is red.

A Blu-ray Disc (BD) drive uses a blue-violet laser. It uses a 405 nm wavelength, which is shorter than the laser used in CD and DVD drives. This shorter wavelength allows for more than five times the data storage per layer on a BD than on a DVD. More data results in higher definition images and audio during playback.

Any removable media drive (CD/DVD/BD) can be installed in one of the drive bays in the computer chassis, or it can be connected to the computer as a peripheral device.



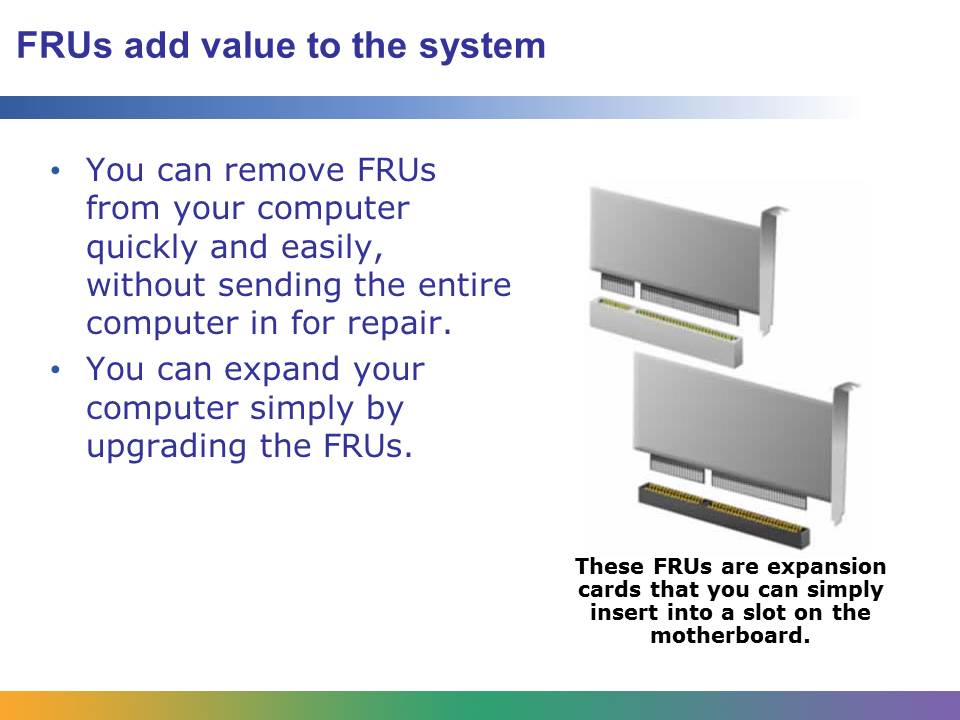
Two different-length slots on the motherboard hold expansion cards such as network and video cards.

To communicate with the monitor, the computer must have a video card, also called a *video adapter*, which is a circuit card that inserts into a slot on the motherboard. Video adapters translate digital information from the processor into usable signals for the monitor, enabling computers to display a full range of visual effects, including graphics, animation, and movies.

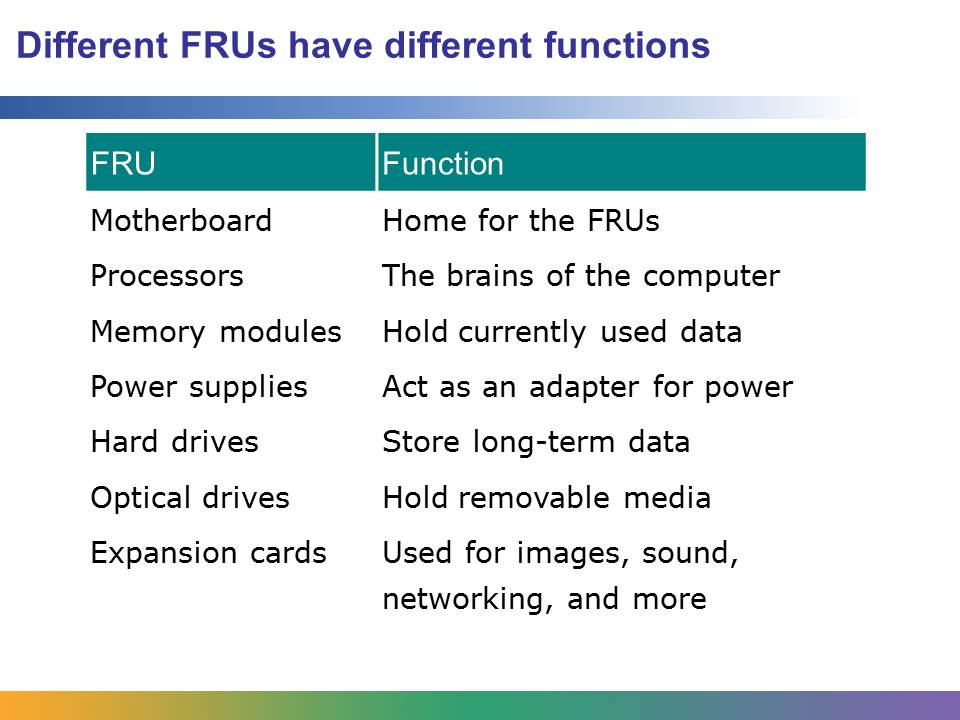
A sound card, also called a *sound board* or *audio adapter*, is an expansion board that enables a computer to record, manipulate, and play sound. The sound card has onboard audio components as well as connections for external audio devices.

A network interface card (NIC) inserts directly into an expansion slot on the motherboard and connects a computer system to network cabling. Computers with 32-bit PCI slots require a 32-bit NIC. The latest and fastest computers use 64-bit PCI slots and 64-bit NICs.

One or more ports on the back of the NIC are used for connecting the computer to network cabling.



FRUs are important components that add value to computer systems. You can remove them from your computer quickly and easily, without sending the entire computer in for repair.



Because you can replace FRUs easily, you can expand your computer when you need more capacity or speed—simply by upgrading the memory, hard drive, expansion card, or other components.

Student Resource 10.3

Scenarios: Troubleshooting FRUs

Student Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_

Directions: Read each scenario. Using the Troubleshooting FRUs flowchart your teacher gives you, determine what you think could have happened to the hardware in each scenario, and explain ways to solve the problem.

Scenario 1

Miguel sits down at his workstation early one morning shortly after the cleaning crew has finished washing all the floors in the building. He pushes the power button on his computer. He waits for his computer to flash the LEDs and make its usual noises, but nothing happens. He pushes the button again, but still nothing happens. He wonders what could be wrong.

Scenario 2

Wanda chases the cat off her table and powers up her desktop computer. It boots, but the display on her monitor is distorted and hard to read. She powers down her computer and tries again, but the screen still shows fuzzy graphics and slanted text. She doesn’t understand what could have happened.

Scenario 3

Reggie is working on a PowerPoint presentation for his English class that is due tomorrow. He is changing the colors on one of the graphics in his file when the cursor suddenly gets stuck in one spot. When he tries to save the file or close the window, his computer won’t respond. He’s worried that he will lose his work.

Scenario 4

Kim powers her laptop on after dinner to find a blue screen with error messages telling her that the computer won’t boot. She powers down her laptop and tries again but gets another blue screen with error messages. There was nothing wrong with her computer before she took it camping last weekend, and she wonders if four years is an average life span for a laptop.

Student Resource 10.4

Worksheet: What Form Factor Is This?

Student Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_

Directions: While your teacher presents information about form factors, take notes by answering the questions on this worksheet.

Introduction

When computer manufacturers design computer systems, one of their goals is to make the most efficient use possible of the space inside the *chassis*, which is also called the *computer case*. They must make sure that the motherboard and power supply fit inside the chassis and that the motherboard has room to hold all the field replaceable units (FRUs) that are needed inside the computer. The size and shape of a device is referred to as its *form factor*. Form factors are governed by industry specifications, which provide design guidance. These specifications take into account electrical, mechanical, structural, thermal, and acoustic performance requirements. They ensure compatibility among manufacturers while allowing different configurations of chassis and power supplies.

Questions

1. What type of form factor does a motherboard in a desktop computer typically use?
2. How does this compare with the motherboard in a laptop?
3. Can you take the motherboard out of one desktop and put it into another desktop? Can you take a motherboard out of one laptop and put it into another laptop? Why or why not?
4. What are the differences between the type of RAM used in desktops and the type used in laptops?
5. Can you take a hard drive out of a desktop and put it into a laptop? Why or why not?

Student Resource 10.5

Worksheet: Ports and Connectors

Student Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_

Directions: Examine the computers in the room, paying attention to the ports and connectors on the back of each chassis. Then fill in the middle two columns of this table. You will complete the first and last columns after the reading. The first row of the worksheet has been started for you as an example.

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Port Sketch and Characteristics | Connector Sketch  and Characteristics | Usage |
|  | thumb screws, nine pins  approx. 1.5 inches wide | thumb screws, holes and slots  approx. 1.5 inches wide |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Student Resource 10.6

Reading: Ports and Connectors

Directions: Match your sketches and descriptions of the ports and cables with those from this reading. Then complete the first and last columns of Student Resource 10.5, Worksheet: Ports and Connectors.

USB

The *universal serial bus* (USB), a type of port commonly found in desktop computers, provides an expandable, low-cost serial interface for adding external peripheral devices to a computer system.

A primary advantage of USB is that it is *hot-swappable* or *hot-pluggable*, terms that refer to the ability to add new devices without having to configure the device or reboot the computer. Because it is designed to be quickly removed and replaced, a USB port has no pins.

The newest version of the USB specification is USB 3.0, which was introduced in 2008 and supports speeds up to 5 Gbps with compatible devices. Original versions provided data transmission speeds up to 1.5 Mbps for low-speed devices and up to 12 Mbps for full-speed devices. The USB 2.0 specification, which was introduced in 2000, transmits data at up to 480 Mbps.

USB has become the standard for low-cost home computing peripherals. If a computer features a USB port, this symbol for a USB port is printed on the back panel of the chassis:



IEEE 1394 or FireWire

The Institute of Electrical and Electronics Engineers (IEEE) 1394 standard supports data transfer rates of 100, 200, or 400 Mbps. *FireWire* is the name trademarked by Apple Inc. for the technology that was accepted as an international standard by the IEEE in 1995. It is formally referred to as the *IEEE 1394 standard*, though some companies use other names, such as i.Link.

IEEE 1394 provides the bandwidth necessary for multimedia streams, which must be delivered within a guaranteed rate to synchronize with audio. One IEEE 1394 port can connect up to 63 devices using cables up to 14-feet long. The ports are hot-pluggable.

IEEE 1394 ports offer a standard connection to a variety of digital consumer electronics, including audio devices, VCRs, and video cameras, as well as traditional computer peripherals such as optical and hard drives. It is likely that the introduction of USB 3.0 will make this interface obsolete within a few years.

VGA



The *video graphics array* (VGA) port is a 15-pin socket on the back of a PC that is used to connect a monitor. Developed by IBM in 1987, the VGA standard uses analog signals rather than digital signals. In graphics mode, the base VGA resolution is 640 x 480 pixels with 16 or 256 colors.

All PCs made today support VGA. Some motherboards have an onboard VGA chip integrated into the motherboard; others support an add-on VGA card.

DVI



The *digital visual interface* (DVI) is a video interface standard that sends a digital signal from the computer’s graphics subsystem to the display. Designed to maximize the visual quality of digital display devices such as flat-panel LCD monitors and digital projectors, it converts analog signals into digital signals to accommodate both analog and digital monitors. Although all LCD monitors are digital, not all LCD monitors have a DVI connection. Most video cards have a DVI port, however, in addition to a VGA connection.

The DVI connector usually contains pins to pass the digital video signals. DVI handles bandwidths of more than 160 MHz.

Onboard Ethernet

Network cards used to be expansion cards that you could add to your computer. However, because the ability to connect to the Internet has become an important requirement, most newer computers have an Ethernet interface built into the motherboard. *Onboard Ethernet ports* originally supported a data transfer rate of 100 Mbps. Newer models support 1,000 Mbps.

An RJ-45 connector is an eight-wire connector that is normally used to connect computers to a local area network (LAN). The cabling is often referred to as CAT5 or CAT6.

Audio Ports

The rear I/O panel of most desktop computers features *audio ports* where you can connect external speakers, a microphone, and other sound inputs. Standard PC-type audio cables are used to connect to these audio ports.

Serial

*Serial ports*, also called *recommended standard-232* (RS-232) or *communication ports*, are bidirectional interfaces that carry data to and from the processor, one bit at a time. Serial ports take 9- or 25-pin male connectors and are labeled as COM1, COM2, COM3, and COM4. They need to be screwed into the I/O plate because they must be secure.

External devices connect to the motherboard through serial ports. Examples of these external devices are mice, scanners, and external modems. Serial ports like this are rapidly becoming obsolete and are being replaced by USB. Newer motherboards may not have this connector.

Parallel

*Parallel ports* connect devices such as printers and scanners to the motherboard. They are 25-pin female connectors that transfer data in 8-bit clusters along parallel lines. Although parallel ports generally transfer data in one direction, they can also function as bidirectional ports.

Computers can have up to three parallel ports. They are labeled LPT1, LPT2, and LPT3. Like serial ports, parallel ports must be screwed into the I/O plate. Parallel ports like this are rapidly becoming obsolete and are being replaced by USB. Newer motherboards may not have this connector.

SCSI



*Small computer system interface (SCSI) ports* are used to connect peripherals such as tape backup units and external hard drives that have been built as SCSI devices. SCSI ports can transmit data faster than serial or parallel ports can. Another advantage of a SCSI port is that you can attach up to seven devices to the same port in a SCSI chain.

With the development of newer serial hard drives, few motherboards still carry a SCSI connection. Some manufacturers still make SCSI connectors for motherboards supporting the PCIe and PCI-X bus interfaces.